SNA0104 4-Bit Bidirectional Voltage-Level Translator

Features

- No Direction-Control
- Data Rates:
  24Mbps (Push-Pull)
  2Mbps (Open-Drain)
- 1.65V to 5.5V on A ports and 2.3V to 5.5V on B Ports ($V_{CCA} \leq V_{CCB}$)
- V_{CC} Isolation: If Either V_{CC} is at GND, Both Ports are in the High-Impedance State
- No Power-Supply Sequencing Required: Either V_{CCA} or V_{CCB} can be Ramped First
- I_{off}: Supports Partial-Power-Down Mode Operation
- Extended Temperature: -40°C to +125°C
- Packages: QFN2X1.7-12L, QFN2*2-12L, QFN3.5*3.5-14L and TSSOP-14

Applications

- Automotive infotainment
- Advanced Driver Assistance System (ADAS)
- Telematics

General Description

This 4-bit non-inverting translator is a bidirectional voltage-level translator and can be used to establish digital switching compatibility between mixed-voltage systems. It uses two separate configurable power-supply rails, with the A ports supporting operating voltages from 1.65V to 5.5V while it tracks the V_{CCA} supply, and the B ports supporting operating voltages from 2.3V to 5.5V while it tracks the V_{CCB} supply. This allows the support of both lower and higher logic signal levels while providing bidirectional translation capabilities between any of the 1.8V, 2.5V, 3.3V and 5V voltage nodes.

When the output-enable (OE) input is low, all I/Os are placed in the high-impedance state, which significantly reduces the power-supply quiescent current consumption. OE has an internal pull-down current source, as long as V_{CCA} is powered.

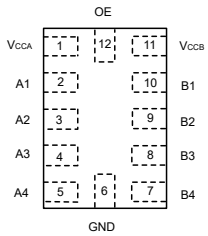
To ensure the high-impedance state during power up or power down, OE should be tied to GND through a pull-down resistor, the minimum value of the resistor is determined by the current-sourcing capability of the driver.

Ordering Information

Part Number	Package	Ordering Number	Packing Option
SNA0104	QFN2X1.7-12L	SNA0104Q01CNB	Tape and Real, 4000
SNA0104	QFN2*2-12L	SNA0104Q00CNB	Tape and Real, 3000
SNA0104	QFN3.5*3.5-14L	SNA0104Q00CNF	Tape and Real, 5000
SNA0104	TSSOP-14	SNA0104Q00CIF	Tape and Real, 4000

Contents

1 Pin Description



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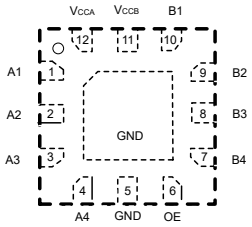

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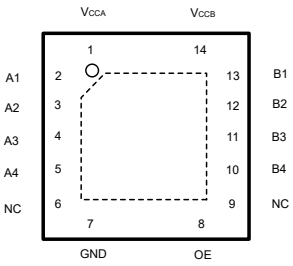

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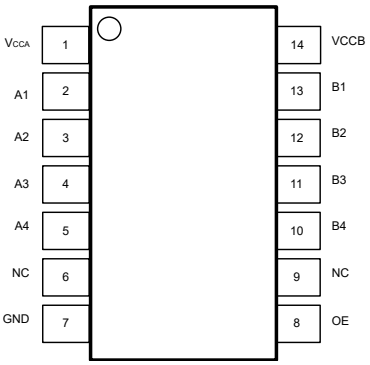


TSSOP-14

Pin				Name	Type	Function
QFN2x1.7-12L	QFN2x2-12L	QFN3.5x3.5-14L	TSSOP-14			
1	12	1	1	V_{CCA}	P	A Port Supply Voltage.1.65V ≤ V_{CCA} ≤ 5.5V and V_{CCA} ≤ V_{CCB}
2	1	2	2	A1	I/O	Input/output A1
3	2	3	3	A2	I/O	Input/output A2
4	3	4	4	A3	I/O	Input/output A3
5	4	5	5	A4	I/O	Input/output A4
		6/9	6/9	NC		No internal connection
6	5	7	7	GND		Ground
12	6	8	8	OE	I	3-state output-mode enable. Pull OE low to place all outputs in 3-state mode. Referenced to V_{CCA}.
7	7	10	10	B4	I/O	Input/output B4
8	8	11	11	B3	I/O	Input/output B3
9	9	12	12	B2	I/O	Input/output B2
10	10	13	13	B1	I/O	Input/output B1
11	11	14	14	V_{CCB}	P	B-port supply voltage 1.65 V ≤ V_{CCB} ≤ 5.5 V
	Thermal Pad (GND)	Thermal Pad				Connect the thermal pad to a large-area GND plane for improved thermal performance

2 Specifications

2.1 Absolute Maximum Ratings

Over recommended operating free-air temperature range (-40°C to 125°C, unless otherwise noted.)[1]

Parameter		Symbol	Min	Max	Unit
Supply voltage range		V_{CCA}	-0.3	6.0	V
Supply voltage range		V_{CCB}	-0.3	6.0	V
Input voltage range[2]	A port	V_I	-0.3	6.0	V
	B port		-0.3	6.0	V
	OE		-0.3	6.0	V
Voltage range applied to any output in the high-impedance or power-off state[2]	A port	V_O	-0.3	6.0	V
	B port		-0.3	6.0	V
Voltage range applied to any output in the high or low state [2][3]	A port	V_O	-0.3	V_{CCA}+0.3	V
	B port		-0.3	V_{CCB}+0.3	V
Input clamp current	V_I<0	I_{IK}		-50	mA
Output clamp current	V_O<0	I_{OK}		-25	mA
Continuous output current		I_O		±50	mA
Continuous current through V_{CCA}, V_{CCA} or GND				±100	mA
Junction Temperature		T_J		150	°C
Storage Temperature		T_{STG}	-65	150	°C

Note:

[1] Stress greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

[2] The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

[3] The value of V_{CCA} and V_{CCB} are provided in the recommended operating conditions table.

2.2 ESD Ratings

Parameter	Symbol		Value	Unit
Electrostatic discharge	V_{ESD}	Human-body model (HBM)	±5000	V
		Machine model (MM)	±400	

ESD SENSITIVITY CAUTION

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could causethe device not to meet its published specifications.

2.3 Recommanded Operating Range

Parameter	Symbol	Conditions		Min	Max	Unit
Supply voltage [1]	V_{CCA}			1.65	5.5	V
	V_{CCB}			2.3	5.5	
High-level input voltage	V_{IH}	A-port I/Os	V_{CCA}=1.65V to 1.95V V_{CCB}=2.3V to 5.5V	V_{CCI}-0.2	V_{CCI}	V
			V_{CCA}=1.95V to 5.5V V_{CCB}=2.3V to 5.5V	V_{CCI}-0.4	V_{CCI}	
		B-port I/Os	V_{CCA}=1.65V to 5.5V V_{CCB}=2.3V to 5.5V	V_{CCI}-0.4	V_{CCI}	
		OE input	V_{CCA}=1.65V to 5.5V V_{CCB}=2.3V to 5.5V	V_{CCA}-0.8	5.5	
Low-level input voltage	V_{IL}	A-port I/Os	V_{CCA}=1.65V to 1.95V V_{CCB}=2.3V to 5.5V	0	0.15	V
			V_{CCA}=1.95V to 5.5V V_{CCB}=2.3V to 5.5V	0	0.15	
		B-port I/Os	V_{CCA}=1.65V to 5.5V V_{CCB}=2.3V to 5.5V	0	0.15	
		OE input	V_{CCA}=1.65V to 5.5V V_{CCB}=2.3V to 5.5V	0	V_{CCA} x 0.25	
Input transition rise or fall	t_r,t_f	A-port I/Os push-pull driving			10	ns/V
		B-port I/Os push-pull driving			10	
		Control input			10	
Operating temperature	T_A			-40	+125	°C

Note:
[1] V_{CCA} must be less than or equal to V_{CCB}.
[2] The maximum V_{IL} value is provided to ensure that a valid V_{OL} is maintained. The V_{OL} value is V_{IL} plus the voltage drop across the pass gate transistor.

2.4 Electrical Characteristics

Limits in standard typeface are for T_A = +25°C, **bold** typeface applies over T_A = -40 to +125°C, unless otherwise noted.

Parameter	Symbol	Conditions	V_{CCA}	V_{CCB}	Min	Typ	Max	Unit
Port A output high voltage	V_{OHA}	I_{OH} = -20μA, V_{IB} ≥ V_{CCB} -0.4V	1.65V to 5.5V	2.3V to 5.5V	**V_{CCA}x0.7**		**5.5**	V
Port A output low voltage	V_{OLA}	I_{OL} = 1mA , V_{IB}≤ 0.15V	1.65V to 5.5V	2.3V to 5.5V			**0.3**	V
Port B output high voltage	V_{OHB}	I_{OH} = -20μA, V_{IA} ≥ V_{CCA} -0.4V	1.65V to 5.5V	2.3V to 5.5V	**V_{CCA}x0.7**			V
Port B output low voltage	V_{OLB}	I_{OH} = 1mA , V_{IA} ≤ 0.15V	1.65V to 5.5V	2.3V to 5.5V			**0.3**	V
Input leakage current	I_I	OE, V_I = V_{CCI} or GND	1.65V to 5.5V	2.3V to 5.5V			±1	μA
							±1.5	μA
Partial power down current	I_{OFF}	A ports	0V	0V to 5.5V			±0.5	μA
							±1	μA
		B ports	0V to 5.5V	0V			±0.5	μA
							±1	μA
High-impedance State output current	I_{OZ}	A or B port, OE=0V	1.65V to 5.5V	2.3V to 5.5V			±0.5	μA
							±1	μA
V_{CCA} supply current	I_{CCA}	V_I = V_O = open, I_O = 0mA	1.65V to 5.5V	2.3V to 5.5V			**1.0**	μA
			5.5V	0V			**1.0**	μA
			0V	5.5V			**-1**	μA
V_{CCB} supply current	I_{CCB}	V_I = V_O = open, I_O = 0mA	1.65V to V_{CCB}	2.3V to 5.5V			**10**	μA
			5.5V	0V			**-1**	μA

Parameter	Symbol	Conditions	V_{CCA}	V_{CCB}	Min	Typ	Max	Unit
			0V	5.5V			1	μA
Combined supply current	$I_{CCA}+I_{CCB}$	V_I = V_O = open, I_O = 0mA	1.65V to V_{CCB}	2.3V to 5.5V			15	μA
V_{CCA} supply current	I_{CCZA}	V_I = V_{CCI} or 0V, I_O = 0mA, OE=0V	1.65V to V_{CCB}	2.3V to 5.5V			1	μA
V_{CCB} supply current	I_{CCZB}	V_I = V_{CCI} or 0V, I_O = 0mA, OE=0V	2.3V to 5.5V	2.3V to 5.5V			1	μA
Input capacitance	C_I	OE	3.3V	3.3V		2.5		pF
Input-to-output internal capacitance	C_{IO}	A port	3.3V	3.3V		5		pF
		B port	3.3V	3.3V		5		pF

Note: V_{CCI} is the V_{CC} associated with the input port. V_{CCO} is the V_{CC} associated with the output port. V_{CCA} must be less than or equal to V_{CCB}.

2.5 Timing Requirements

V_{CCA} = 1.8V±0.15V

		V_{CCB} = 2.5V ±0.2V (TYP)	V_{CCB} = 3.3V ±0.2V (TYP)	V_{CCB} = 5V ±0.2V (TYP)	Unit
Data rate	Push-pull driving	21	22	24	Mbps
	Open-drain driving	2	2	2	Mbps
Pulse duration	Push-pull driving (data inputs)	47	45	41	ns
	Open-drain driving (data inputs)	500	500	500	ns

V_{CCA} = 2.5V±0.15V

		V_{CCB} = 2.5V ±0.2V (TYP)	V_{CCB} = 3.3V ±0.2V (TYP)	V_{CCB} = 5V ±0.2V (TYP)	Unit
Data rate	Push-pull driving	20	22	24	Mbps
	Open-drain driving	2	2	2	Mbps
Pulse duration	Push-pull driving (data inputs)	50	45	41	ns
	Open-drain driving (data inputs)	500	500	500	ns

V_{CCA} = 3.3V±0.15V

		V_{CCB} = 2.5V ±0.2V (TYP)	V_{CCB} = 3.3V ±0.2V (TYP)	Unit
Data rate	Push-pull driving	23	24	Mbps
	Open-drain driving	2	2	Mbps
Pulse duration	Push-pull driving (data inputs)	43	41	ns
	Open-drain driving (data inputs)	500	500	ns

V_{CCA} = 5V±0.15V

		V_{CCB} = 5V ±0.2V (TYP)	Unit
Data rate	Push-pull driving	24	Mbps
	Open-drain driving	2	Mbps
Pulse duration	Push-pull driving (data inputs)	41	ns
	Open-drain driving (data inputs)	500	ns

2.6 Switching Characteristics: V_{CCA} = 1.8V ± 0.15V

Over recommended operating free-air temperature range (-40°C to 125°C, unless otherwise noted.)

Parameter	Symbol	Conditions		V_{CCB}=2.5V ±0.2V (TYP)	V_{CCB}=3.3V ±0.2V (TYP)	V_{CCB}=5V ±0.2V (TYP)	Unit
Propagation delay time high-to-low output	t_{PHL}	A-to-B	Push-pull driving	2.5	3.1	4.5	ns
			Open-drain driving	26.1	26.4	26.6	ns
Propagation delay time low-to-high output	t_{PLH}	A-to-B	Push-pull driving	4.2	3.7	3.6	ns
			Open-drain driving	221	183	143	ns
Propagation delay time high-to-low output	t_{PHL}	B-to-A	Push-pull driving	2.1	2.0	2.2	ns
			Open-drain driving	26.1	26.1	26.2	ns
Propagation delay time low-to-high output	t_{PLH}	B-to-A	Push-pull driving	1.8	1.6	1.5	ns
			Open-drain driving	173	89	66	ns
Enable time	t_{en}	OE-to-A or B		25	21	19	ns
Disable time	t_{dis}	OE-to-A or B		1250	1250	1250	ns
Input rise time	t_{rA}	A port rise time	Push-pull driving	6.9	6.1	5.6	ns
			Open-drain driving	118	39	13	ns
Input rise time	t_{rB}	B port rise time	Push-pull driving	5.8	4.8	4.1	ns
			Open-drain driving	166	127	75	ns
Input fall time	t_{fA}	A port fall time	Push-pull driving	3.0	2.8	2.7	ns
			Open-drain driving	1.9	1.7	1.6	ns
Input fall time	t_{fB}	B port fall time	Push-pull driving	4.8	6.2	8.4	ns
			Open-drain driving	2.3	2.4	2.8	ns
Skew(time), output	$t_{SK(O)}$	Channel-to-Channel Skew		0.5	0.5	0.5	ns
Maximum data rate		Push-pull driving		21	22	24	Mbps
		Open-drain driving		2	2	2	Mbps

2.7 Switching Characteristics: V_{CCA} = 2.5V ± 0.15V

Over recommended operating free-air temperature range (-40°C to 125°C, unless otherwise noted.)

Parameter	Symbol	Conditions		V_{CCB}=2.5V ±0.2V (TYP)	V_{CCB}=3.3V ±0.2V (TYP)	V_{CCB}=5V ±0.2V (TYP)	Unit
Propagation delay time high-to-low output	t_{PHL}	A-to-B	Push-pull driving	2.8	3.4	5.0	ns
			Open-drain driving	26.3	26.5	26.6	ns
Propagation delay time low-to-high output	t_{PLH}	A-to-B	Push-pull driving	2.7	2.5	2.4	ns
			Open-drain driving	198	169	131	ns
Propagation delay time high-to-low output	t_{PHL}	B-to-A	Push-pull driving	2.5	2.4	2.5	ns
			Open-drain driving	26.4	26.5	26.6	ns
Propagation delay time low-to-high output	t_{PLH}	B-to-A	Push-pull driving	2.1	2.0	1.9	ns
			Open-drain driving	196	138	63	ns
Enable time	t_{en}	OE-to-A or B		24	20	17	ns
Disable time	t_{dis}	OE-to-A or B		1250	1250	1250	ns
Input rise time	t_{rA}	A port rise time	Push-pull driving	3.4	2.9	2.7	ns
			Open-drain driving	156	92	13	ns
Input rise time	t_{rB}	B port rise time	Push-pull driving	4.7	3.5	2.7	ns
			Open-drain driving	160	124	81	ns
Input fall time	t_{fA}	A port fall time	Push-pull driving	5.1	5.2	5.0	ns
			Open-drain driving	2.1	2.0	1.8	ns
Input fall time	t_{fB}	B port fall time	Push-pull driving	5.0	6.4	8.7	ns
			Open-drain driving	2.0	2.2	2.8	ns
Skew(time), output	$t_{SK(O)}$	Channel-to-Channel Skew		0.5	0.5	0.5	ns
Maximum data rate		Push-pull driving		20	22	24	Mbps
		Open-drain driving		2	2	2	Mbps

2.8 Switching Characteristics: V_{CCA} = 3.3V ± 0.3V

Over recommended operating free-air temperature range (-40°C to 125°C, unless otherwise noted.)

Parameter	Symbol	Conditions		V_{CCB}=3.3V ±0.2V(TYP)	V_{CCB}=5V ±0.2V(TYP)	Unit
Propagation delay time high-to-low output	t_{pHL}	A-to-B	Push-pull driving	3.6	5.1	ns
			Open-drain driving	26.4	26.6	ns
Propagation delay time low-to-high output	t_{PLH}	A-to-B	Push-pull driving	2.3	2.1	ns
			Open-drain driving	155	109	ns
Propagation delay time high-to-low output	t_{PHL}	B-to-A	Push-pull driving	3.1	3.3	ns
			Open-drain driving	26.5	26.7	ns
Propagation delay time low-to-high output	t_{PLH}	B-to-A	Push-pull driving	1.9	1.8	ns
			Open-drain driving	158	87	ns
Enable time	t_{en}	OE-to-A or B		19	15	ns
Disable time	t_{dis}	OE-to-A or B		1250	1250	ns
Input rise time	t_{rA}	A port rise time	Push-pull driving	2.3	2.1	ns
			Open-drain driving	117	48	ns
Input rise time	t_{rB}	B port rise time	Push-pull driving	3.0	2.4	ns
			Open-drain driving	117	75	ns
Input fall time	t_{fA}	A port fall time	Push-pull driving	8.0	7.6	ns
			Open-drain driving	2.2	2.1	ns
Input fall time	t_{fB}	B port fall time	Push-pull driving	8.2	10.8	ns
			Open-drain driving	2.1	2.4	ns
Skew(time), output	$t_{SK(O)}$	Channel-to-Channel Skew		0.5	0.5	ns
Maximum data rate		Push-pull driving		23	24	Mbps
		Open-drain driving		2	2	Mbps

2.9 Switching Characteristics: V_{CCA} = 5.0V ± 0.35V

Over recommended operating free-air temperature range (-40°C to 125°C, unless otherwise noted.)

Parameter	Symbol	Conditions		V_{CCB}=5V ±0.2V(TYP)	Unit
Propagation delay time high-to-low output	t_{pHL}	A-to-B	Push-pull driving	5.6	ns
			Open-drain driving	26.8	ns
Propagation delay time low-to-high output	t_{PLH}	A-to-B	Push-pull driving	2.0	ns
			Open-drain driving	155	ns
Propagation delay time high-to-low output	t_{PHL}	B-to-A	Push-pull driving	5.8	ns
			Open-drain driving	27.5	ns
Propagation delay time low-to-high output	t_{PLH}	B-to-A	Push-pull driving	1.8	ns
			Open-drain driving	160	ns
Enable time	t_{en}	OE-to-A or B		17	ns
Disable time	t_{dis}	OE-to-A or B		1250	ns
Input rise time	t_{rA}	A port rise time	Push-pull driving	1.9	ns
			Open-drain driving	105	ns
Input rise time	t_{rB}	B port rise time	Push-pull driving	2.3	ns
			Open-drain driving	95	ns
Input fall time	t_{fA}	A port fall time	Push-pull driving	9.0	ns
			Open-drain driving	2.6	ns
Input fall time	t_{fB}	B port fall time	Push-pull driving	8.9	ns
			Open-drain driving	2.5	ns
Skew(time), output	$t_{SK(O)}$	Channel-to-Channel Skew		0.5	ns
Maximum data rate		Push-pull driving		24	Mbps
		Open-drain driving		2	Mbps

3 Performance Characteristics

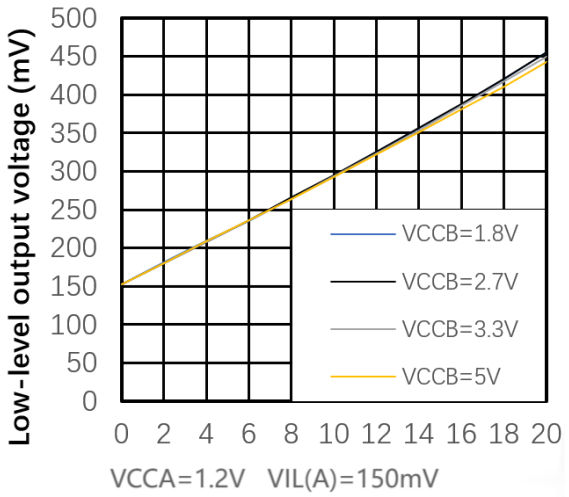


Figure 3-1 Low-Level Output Voltage vs Low-Level Current

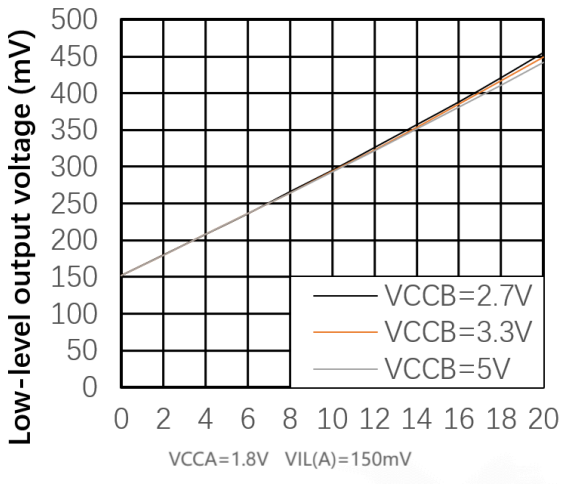


Figure 3-2 Low-Level Output Voltage vs Low-Level Current

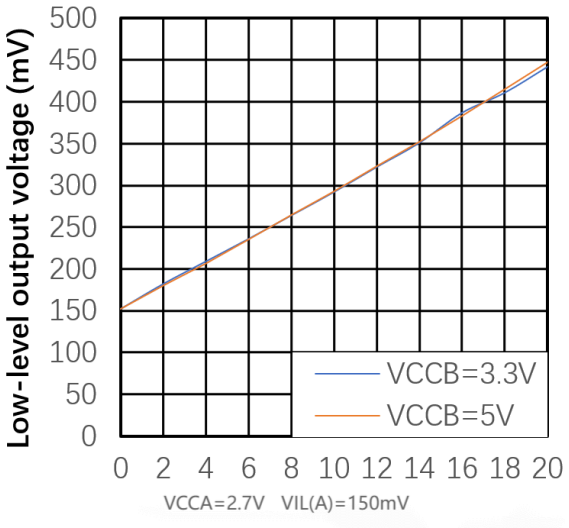


Figure 3-3 Low-Level Output Voltage vs Low-Level Current

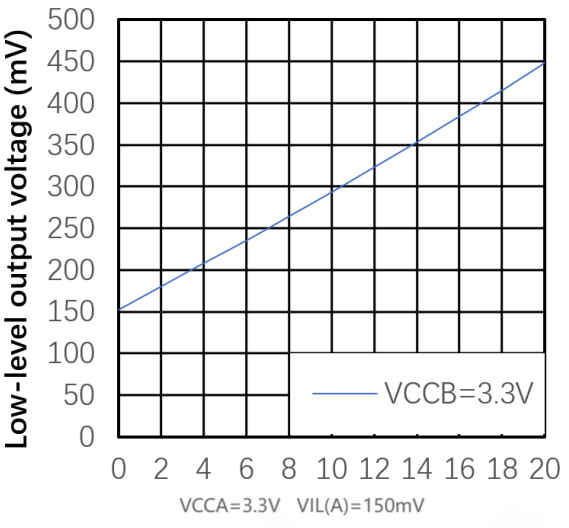


Figure 3-4 Low-Level Output Voltage vs Low-Level Current

4 Parameter Measurement Information

Unless otherwise noted, all input pulses are supplied by generators having the following characteristics:

- PRR 10MHz
- Z_O = 50 Ω
- d_v/d_t ≥ 1 V/ns

Note: All input pulses are measured one at a time, with one transition per measurement.

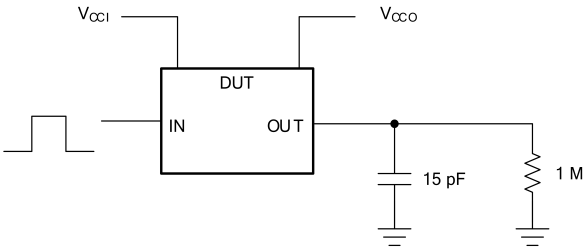


Figure 4-1 Data Rate, Pulse Duration, Propagation Delay, Output Rise and Fall Time Measurement Using A Push-Pull Driver

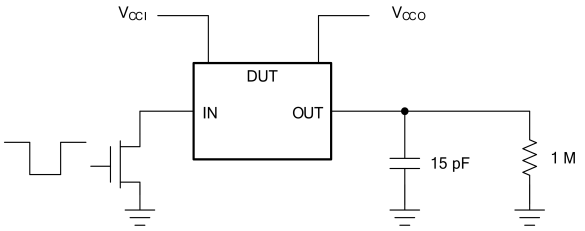


Figure 4-2 Data Rate, Pulse Duration, Propagation Delay, Output Rise and Fall Time Measurement Using an Open-Drain Driver

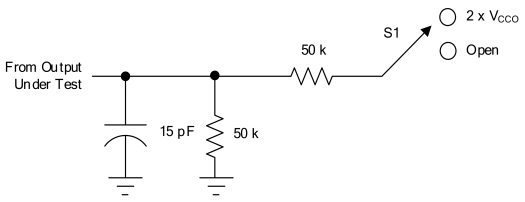


Figure 4-3 Load Circuit for Enable/Disable Time Measurement

TEST	S1
t_{PZL}/t_{PLZ}	2 x V_{CCO}
t_{PHZ}/t_{PZH}	Open

Note:
[1] t_{PLZ} and t_{PHZ} are the same as t_{dis}.
[2] t_{PZL} and t_{PZH} are the same as t_{en}.

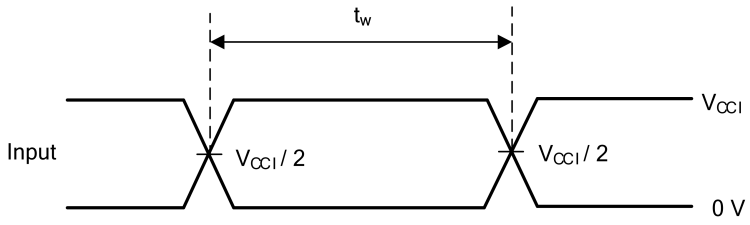


Figure 4-4 Voltage Waveforms Pulse Duration

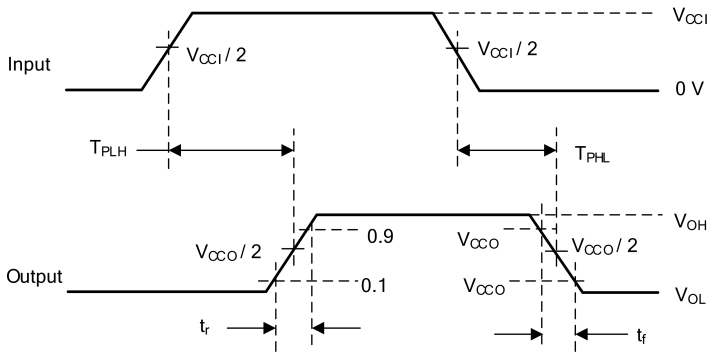


Figure 4-5 Voltage Waveforms Propagation Delay Times

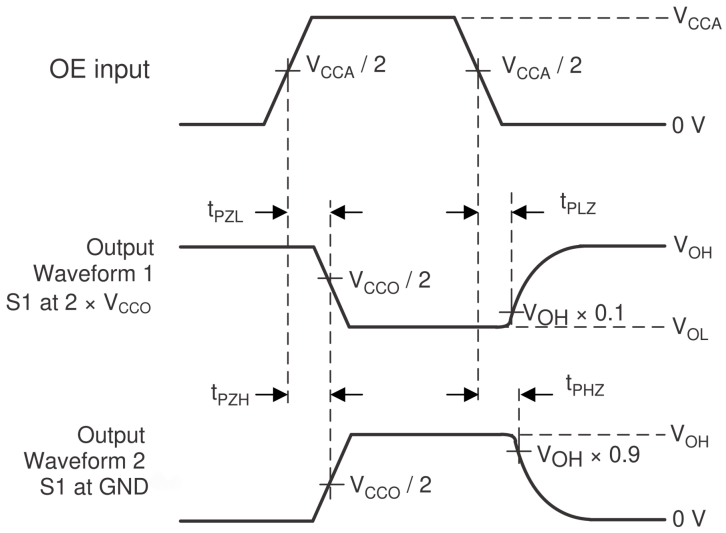


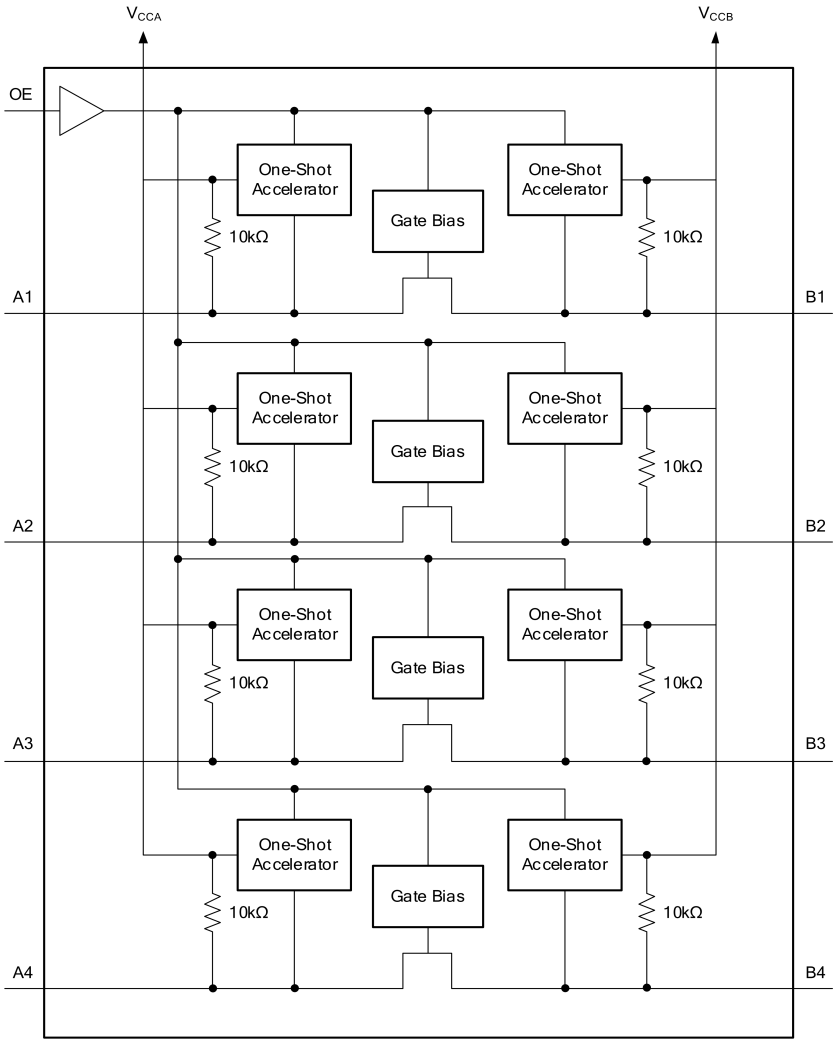
Figure 4-6 Voltage Waveforms Enable and Disable

5 Detailed Description

5.1 Overview

The SNA0104 device is a directionless voltage-level translator specifically designed for translating logic voltage levels. The A port is able to accept I/O voltages ranging from 1.65V to 5.5V, while the B port can accept I/O voltages from 2.3V to 5.5V. The device is a pass-gate architecture with edge-rate accelerators (one-shots) to improve the overall data rate. 10kΩ pullup resistors, commonly used in open-drain applications, have been conveniently integrated so that an external resistor is not needed. While this device is designed for open-drain applications, the device can also translate push-pull CMOS logic outputs.

5.2 Functional Block Diagram



5.3 Architecture

The SNA0104 architecture is an auto-direction-sensing based translator that does not require a direction-control signal to control the direction of data flow from A to B or from B to A. These two bidirectional channels independently determine the direction of data flow without a direction-control signal. Each I/O pin can be automatically reconfigured as either an input or an output, which is how this auto-direction feature is realized.

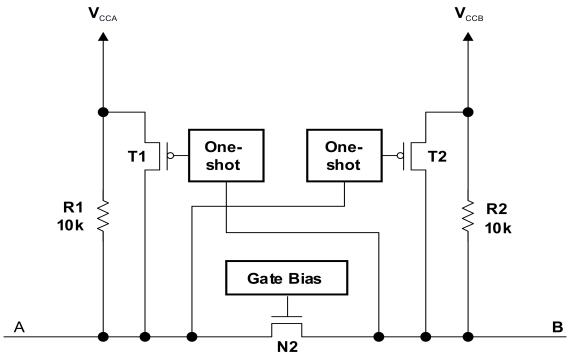


Figure 5-1 Architecture of a SNA0104 Cell

The SNA0104 employs two key circuits to enable this voltage translation:

- An N-channel pass-gate transistor topology that ties the A-port to the B-port.
- Output one-shot (O.S.) edge-rate accelerator circuitry to detect and accelerate rising edges on the A or B Ports.

5.4 Input Driver Requirements

The continuous dc-current "sinking" capability is determined by the external system-level open-drain (or push - pull) drivers that are interfaced to the SNA0104 I/O pins. Since the high bandwidth of these bidirectional I/O circuits is used to facilitate this fast change from an input to an output and an output to an input, they have a modest dc-current "sourcing" capability of hundreds of micro-Amps, as determined by the internal 10kΩ pullup resistors.

The fall time (t_{fA}, t_{fB}) of a signal depends on the edge-rate and output impedance of the external device driving SNA0104 data I/Os, as well as the capacitive loading on the data lines.

Similarly, the t_{PHL} and max data rates also depend on the output impedance of the external driver. The values for t_{fA}, t_{fB}, t_{PHL} and maximum data rates in the data sheet assume that the output impedance of the external driver is less than 50Ω.

5.5 Output Load Considerations

We recommend careful PCB layout practices with short PCB trace lengths to avoid excessive capacitive loading and to ensure that proper O.S. triggering takes place. PCB signal trace-lengths should be kept short enough such that the round-trip delay of any reflection is less than the one-shot duration. This improves signal integrity by ensuring that any reflection sees a low impedance at the driver. The O.S. circuits have been designed to stay on for approximately 30ns. The maximum capacitance of the lumped load that can be driven also depends directly on the one-shot duration. With very heavy capacitive loads, the one-shot can time-out before the signal is driven fully to the positive rail. The O.S. duration has been set to best optimize trade-offs between dynamic I_{CC}, load driving capability, and maximum bit-rate considerations. Both PCB trace length and connectors add to the capacitance that the SNA0104 device output sees, so it is recommended that this lumped-load capacitance be considered to avoid O.S. retriggering, bus contention, output signal oscillations, or other adverse system-level affects.

5.6 Enable and Disable

The SNA0104 device has an OE input that is used to disable the device by setting OE low, which places all I/Os in the Hi-Z state. The disable time (t_{dis}) indicates the delay between the time when OE goes low and when the outputs are disabled (Hi-Z). The enable time (t_{en}) indicates the amount of time the user must allow for the one-shot circuitry to become operational after OE is taken high.

5.7 Pullup or Pulldown Resistors on I/O Lines

Each A-port I/O has an internal 10kΩ pullup resistor to V_{CCA}, and each B-port I/O has an internal 10kΩ pullup resistor to V_{CCB}. If a smaller value of pullup resistor is required, an external resistor must be added from the I/O to V_{CCA} or V_{CCB} (in parallel with the internal 10kΩ resistors). Adding lower value pull-up resistors will affect V_{OL} levels, however. The internal pull-ups of the SNA0104 are disabled when the OE pin is low.

6 Application Information

The SNA0104 device can be used to bridge the digital-switching compatibility gap between two voltage nodes to successfully interface logic threshold levels found in electronic systems. It should be used in a point-to-point topology for interfacing devices or systems operating at different interface voltages with one another. Its primary target application use is for interfacing with open-drain drivers on the data I/Os such as I2C or 1-wire, where the data is bidirectional and no control signal is available. The device can also be used in applications where a push-pull driver is connected to the data I/Os, but the SNA0104 might be a better option for such push-pull applications.

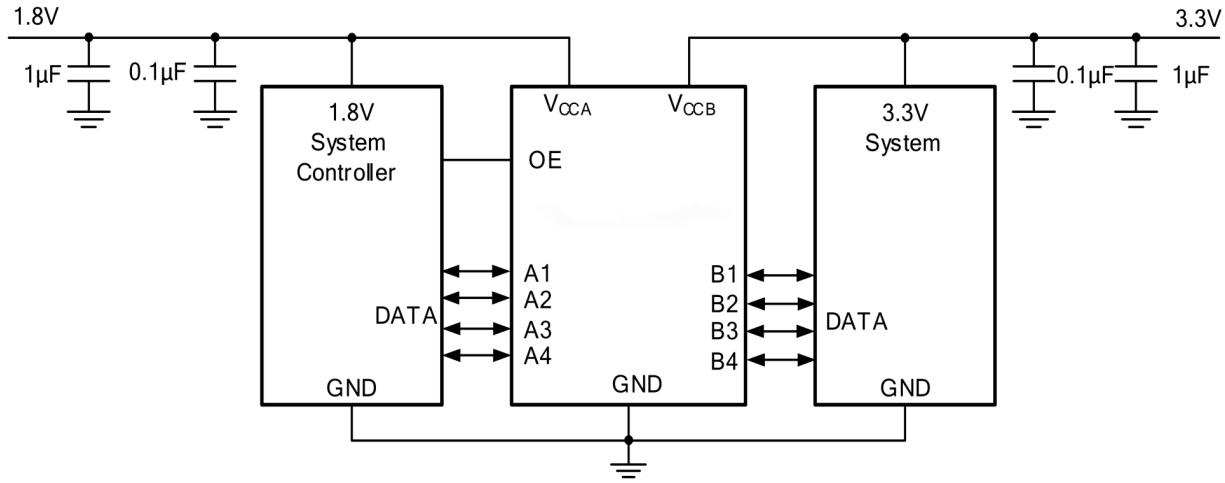
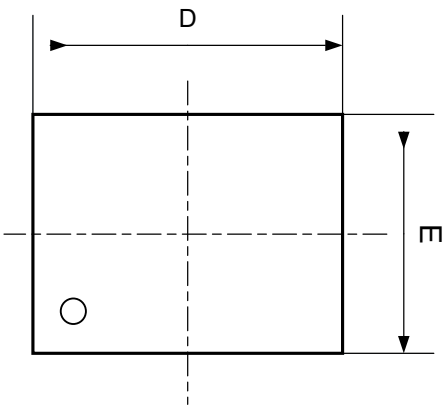


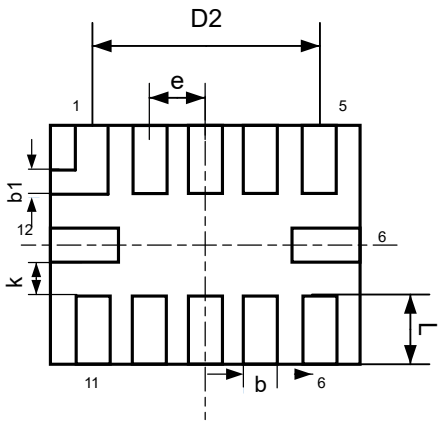
Figure 6-1 Typical Application Circuit

7 Package Outline

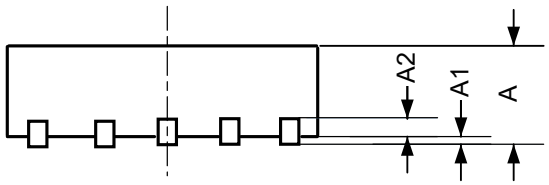
7.1 QFN2x1.7-12L



TOP VIEW



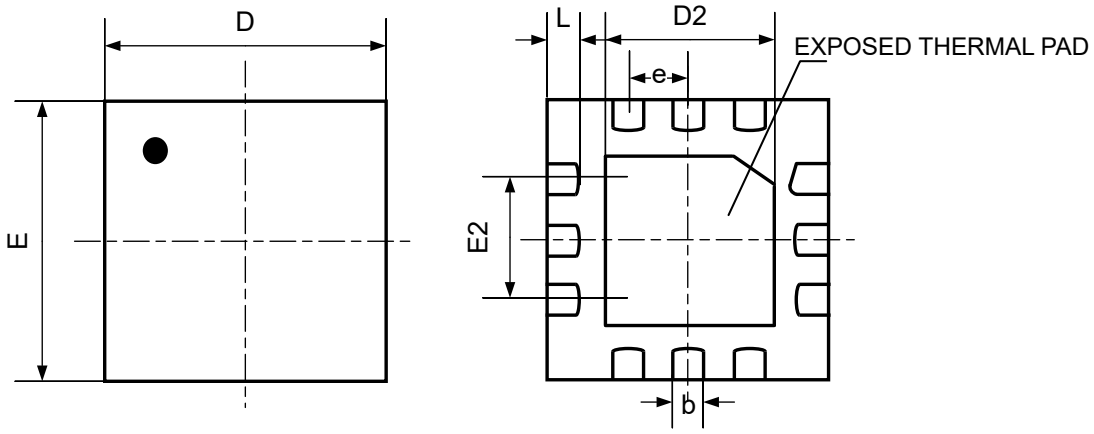
BOTTOM VIEW

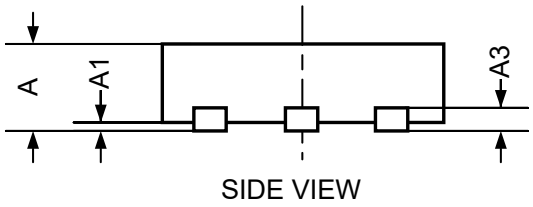


SIDE VIEW

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	0.450	0.550	0.018	0.022
A1	0.000	0.050	0.000	0.002
A2	0.152 REF		0.006 REF	
b	0.150	0.250	0.006	0.010
D	1.900	2.100	0.075	0.083
E	1.600	1.800	0.063	0.071
D2	1.500	1.700	0.059	0.067
b1	0.150 REF		0.006 REF	
k	0.250 REF		0.010 REF	
e	0.400 BSC		0.016 BSC	
L	0.400	0.600	0.016	0.024

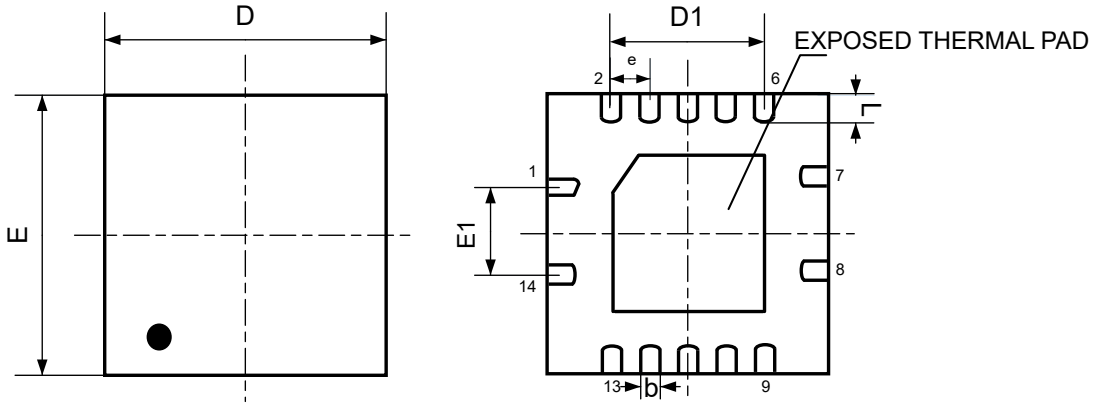
7.2 QFN2x2-12L



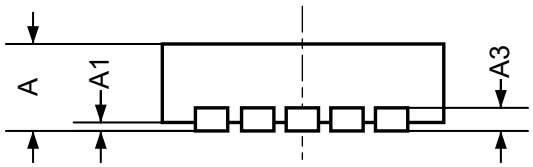


Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	0.450	0.550	0.018	0.022
A1	0.000	0.050	0.000	0.002
A2	0.100	0.200	0.004	0.008
b	0.150	0.250	0.006	0.010
D	1.900	2.100	0.075	0.083
E	1.900	2.100	0.075	0.083
D2	1.000	1.200	0.039	0.057
E2	1.000	1.200	0.039	0.057
e	0.400 BSC		0.016 BSC	
L	0.150	0.250	0.006	0.010

7.3 QFN3.5x3.5-14L



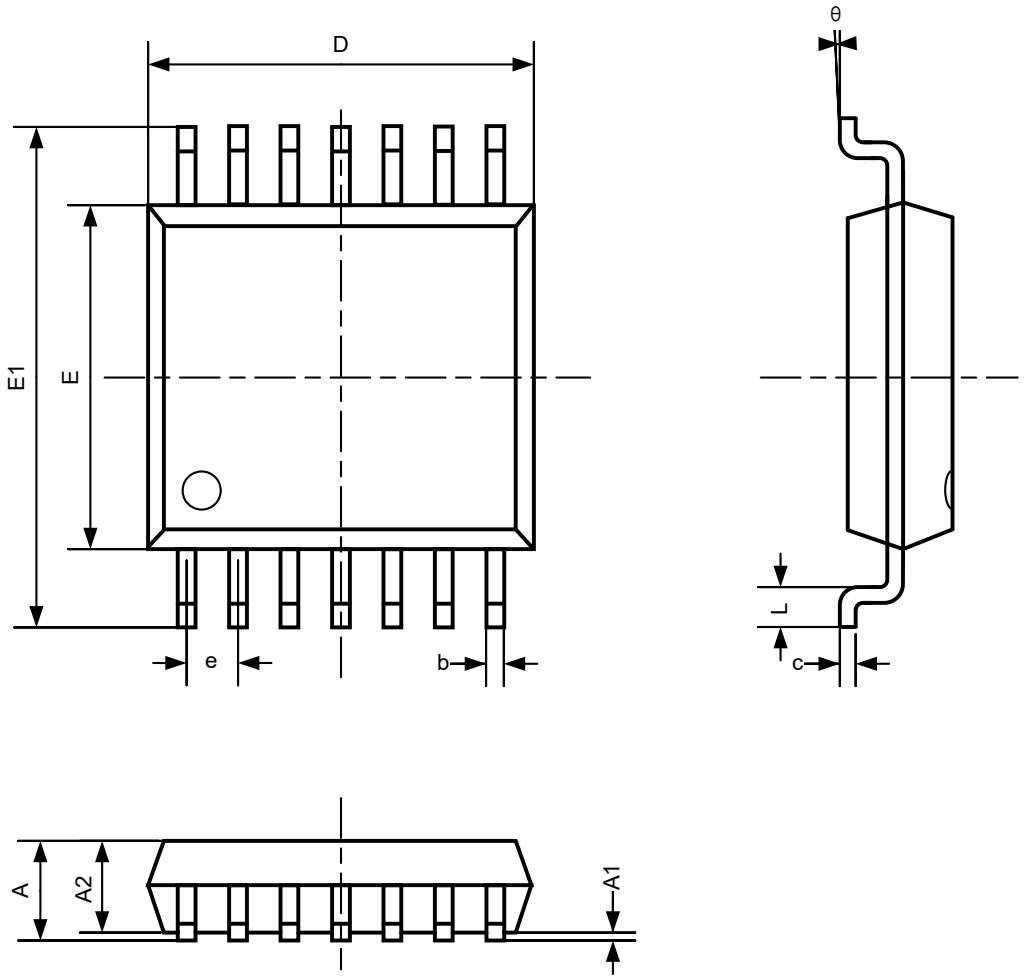
TOP VIEW BOTTOM VIEW



SIDE VIEW

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	0.700	0.900	0.028	0.035
A1	0.000	0.050	0.000	0.002
A2	0.200 REF		0.008 REF	
b	0.180	0.300	0.007	0.012
D	3.350	3.650	0.075	0.083
E	3.350	3.650	0.075	0.083
D1	2.000 TYP		0.079 TYP	
E1	1.500 TYP		0.059 TYP	
e	0.500 TYP		0.020 TYP	
L	0.300	0.500	0.012	0.020

7.4 TSSOP-14



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.000	0.031	0.039
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.900	5.100	0.193	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500	0.700	0.020	0.028
θ	1°	7°	1°	7°

8 Revision History

Version	Date	Description
0.1	2022/08/12	Initial release
0.2	2023/05/06	Add packages: QFN2X1.7-12L, QFN2*2-12L, QFN3.5*3.5-14L